



TITLE:

SPECIFICATION FOR SINGLE-PHASE SPLIT PREPAYMENT DIN RAIL MOUNTING STATIC WATT - HOUR METERS FOR ACTIVE ENERGY- Using PLC as Medium of Communication Between MCU and UIU

Doc. No.

**KP1/6C/4/1/TSP/14/1
1-02**

Issue No.

1

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Single-Phase Split Prepayment Din-rail Mounting Static Watt-hour Meter for Active Energy- Using Power Line Carrier (PLC) as Medium of Communication Between Measurement and Control Unit (MCU) and User Interface Unit (UIU)-Specification

A Document of the Kenya Power & Lighting Co. Ltd

October 2017

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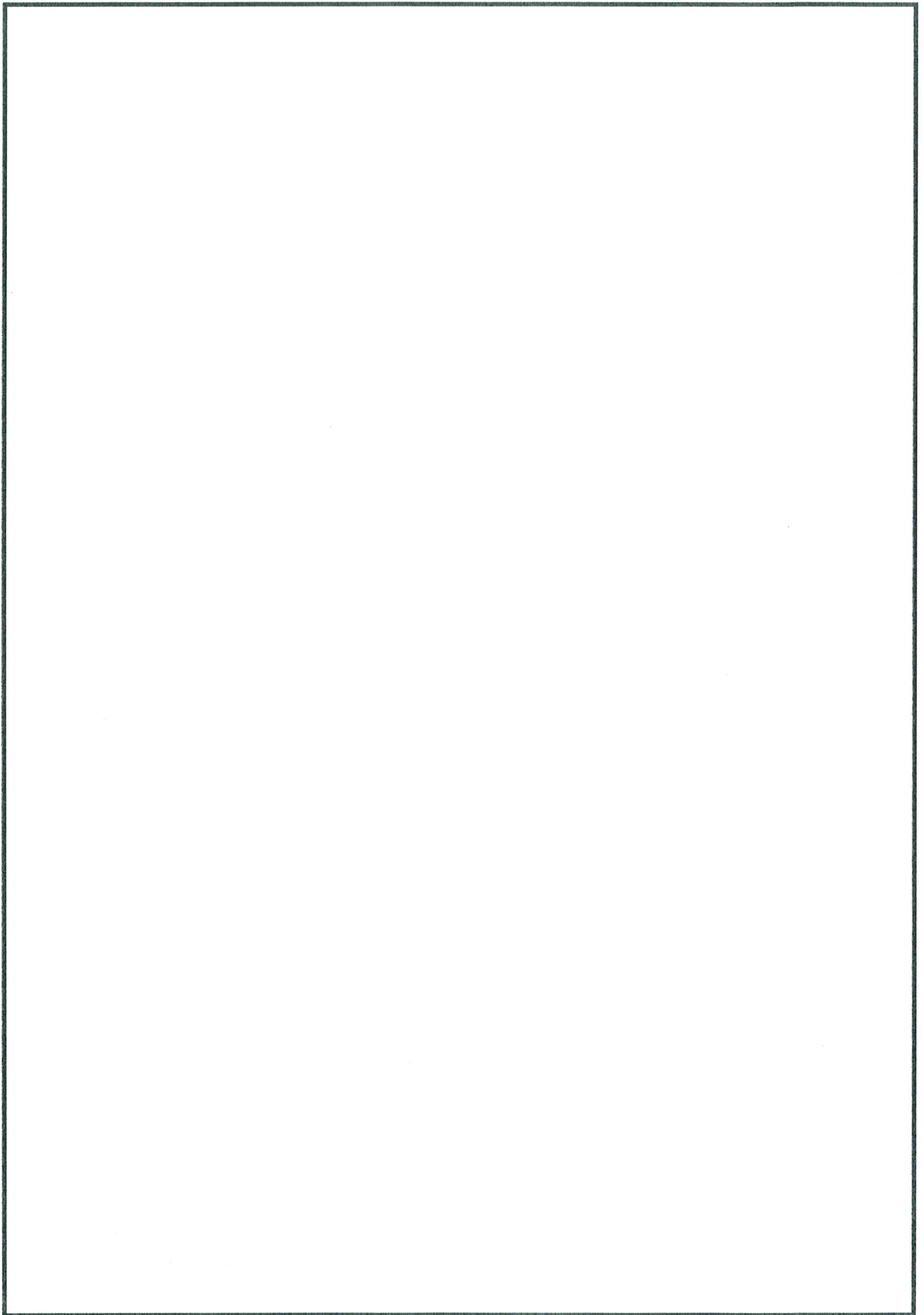
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0.1 Circulation List

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REVISION OF KPLC STANDARDS

To keep abreast of progress in the industry, KPLC specifications shall be regularly reviewed. Suggestions for improvements to approved specifications addressed to the Manager, Standards Department are welcome.

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0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
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FOREWORD

This Specification has been prepared by the Customer Service Division in collaboration with Standards Department, all of The Kenya Power & Lighting Company Limited (abbreviated as KPLC). It lays down requirements for single-phase DIN-rail mounting split prepayment meters for active energy.

The Specification establishes uniform requirements for Single-Phase Split Prepayment Meters for active energy, using Power Line Carrier (PLC) as the means of communication between Measurement and Control Unit (MCU) and User Interface Unit (UIU).

The Specification is intended for use by KPLC in procurement of single phase prepayment meters and does not purport to include provisions of a contract.

1. SCOPE

This Specification applies to newly manufactured, Single-Phase Din-Rail Mounting Static Watt-Hour Prepayment Meters for direct connection in measurement of alternating current electrical energy consumption at a nominal frequency of 50 Hz.

The Specification also covers inspections and tests of the meters as well as schedule of Guaranteed Technical Particulars to be filled, signed by the manufacturer and submitted for tender evaluation.

The Specification stipulates the minimum requirements for Single-Phase Din-Rail Mounting Static Watt-Hour Prepayment Meters acceptable for use in the Company (KPLC) and it shall be the responsibility of manufacturer to ensure adequacy of the design, good workmanship, good engineering practice and adherence to standards, specifications and applicable regulations in the manufacture of the meters for KPLC.

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2. NORMATIVE REFERENCES

The following Standards contain provisions, which through reference in text constitute provisions of this Specification. Unless otherwise stated, the latest Editions (including amendments) apply. In case of conflict, the requirements of this Specification take precedence.

IEC 60695-2-1	Fire Hazards Testing-Part 2-Test Methods-Section 1/sheet: Glow-wire end-product test and guidance
IEC 61000-4-5	Electromagnetic Capability, Testing and measurement Techniques, Surge immunity test
IEC 61010-1:2010	Safety requirements for electrical equipment for measurement, control, and laboratory use-Part 1: General requirements
IEC 61140:2016	Protection against electric shock-common aspects for installation and equipment
IEC 61358	Acceptance inspection for directly connected meters
IEC 61358:1996	Acceptance inspection for direct connected AC static Watt hour meter for active energy (class 1 & 2)
IEC 61557	Electrical safety in low voltage distribution systems up to 1000V a.c. and 1,500V d.c. – Equipment for Testing, measuring or monitoring of protective measures-Part 1: General Requirements
IEC 60529	Degrees of protection provided by Enclosures (IP Code)
IEC 62052-11:2003	Electricity Metering equipment (a.c) – General Requirements, Tests and Test Conditions- PART 11: Metering equipment.
IEC 62053-21:2003	Electricity metering equipment (a.c) – Particular Requirements - Part 21: Static meters for active energy (class 1.0).
IEC 62055-31:2005	Electricity metering – Payment systems – Part 31: Particular requirements – Static payment meters for active energy (classes 1 and 2).
IEC 62056-21	Electrical metering equipment (a.c)-Particular requirements -Part 21: Static Meters for active energy (classes 1 and 2)

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IEEE1901.2 Standard for Low Frequency (Less than 500 kHz) Narrow Band Power Line Carrier for Smart Grid Applications.

SANS1524-1:2004 Electricity prepayment Systems, Part 1: Prepayment meters.

3. DEFINITIONS AND ABBREVIATIONS

For the purposes of this Specification, the Terms, Definitions and Abbreviations given in the Reference Standards apply, and shall include the following:

DC	Direct Current
DLMS/COSEM	Device Language Message Specification/Companion Specification for Energy Metering
Hz	Hertz
KPLC	Kenya Power & Lighting Company Limited
kV	Kilovolt
KWH	Kilowatt-hour
LCD	Liquid crystal display
LED	Light emitting diode
MCU	Measurement and Control Unit
MDMS	Meter Data Management System
OFDM	Orthogonal Frequency Division-Multiplexing
PLC	Power Line Carrier
SRE	Significant Reverse Energy
STS	Standard Transfer Specification
UIU	User Interface Unit

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4. REQUIREMENTS

4.1 Operating Conditions

4.1.1 Operating Environmental Conditions

The meters shall be suitable for continuous outdoor operation in tropical climate with the following conditions:

- a) Altitude: Up to 2,200m above sea level (ASL)
- b) Temperature: Average of 30° C with a minimum of -1° C and maximum of +55° C
- c) Humidity: Up to 95%
- d) Pollution: Pollution level III ('Heavy')

4.1.2 System Characteristics

4.1.2.1. The meter will be connected to an overhead or underground earthed system

4.1.2.2 The nominal voltage (U_n) is 230 volts, 50Hz.

4.2 Design and Construction Requirements

4.2.1 General Requirements

- 4.2.1.1 The Measurement and Control Unit (MCU) shall be of DIN rail mounting with locking clip, to fit to a 35 mm DIN rail.
- 4.2.1.2 The MCU and User Interface Unit (UIU) shall communicate via Power Line Carrier(PLC) for a distance not less than one hundred (100) meters.
- 4.2.1.3 The meters shall be constructed as Single-Phase 2-Wire Direct-Connected Prepayment Meter.
- 4.2.1.4 The meter shall have terminals as in Figure 1. The connections to the meter shall be Bottom-in, Bottom-Out and with Line-in Neutral-In terminals at the base level to allow racking of the meter on a test bench. The meter terminals shall have a protection cover with sealable Nickel-plated steel screws to protect against tampering and ingress of water. The protection cover shall be transparent and shall ensure adequate coverage of all the terminals. The connections shall be as illustrated in Figure 1.

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N.B: Terminals 1 & 2 for Line In, Neutral In and terminals 3&4 for Line Out, Neutral Out Respectively

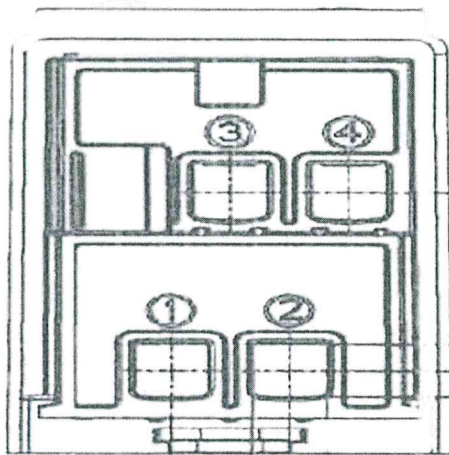


Figure 1. Terminals Configuration

- 4.2.1.5 The MCU dimensions shall not exceed: Height = 170 mm; Width = 60 mm; and Depth = 95 mm; and meter base shall be on the width side where the Din rail mount shall be located.
- 4.2.1.6 The MCU body shall be ultrasonically sealed for life and there shall be no screws on the MCU body except for the termination of cables.
- 4.2.1.7 The meter shall have terminal cover open detection mechanism. Once the terminal cover is opened, the load shall be disconnected. The mechanism shall be designed to operate as in sub-clauses (a) to (c) below:
- (a) The MCU shall be supplied with loading switch in open mode and installer can open terminal cover when MCU is not activated by commissioning code (token).
 - (b) After installation of MCU, the installer will input a commission code (token) to close the loading switch and activate terminal cover open detection function.
 - (c) After commissioning token is put into the MCU and loading switch closes, opening of the terminal cover shall lead to tamper. When MCU has power and terminal cover is opened, MCU will disconnect immediately. When MCU has no power and terminal cover is opened, MCU will detect and record the event and disconnect immediately power resumes.


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- 4.2.1.8 The MCU shall be sealed and its Printed Circuit Boards conformal coated in a manner so as not to allow malfunction due to ingress of moisture, vermin, dust, chemicals and temperature extremes.
- 4.2.1.9 The meters terminal illustrated in Figure 1 shall have holes and screws of Moving-cage type made of brass or nickel-plated brass for high conductivity and corrosion resistance. The terminals shall be of suitable rating to carry continuously 125% I_{max}.
- 4.2.1.10 Terminal holes shall be of at least 10-mm diameter and 15mm in depth. The dimension from the Line-in, Neutral-in terminal holes to meter base shall not exceed 20mm.
- 4.2.1.11 The meter's terminal screw inserts shall be sealable with utility wire seals.
- 4.2.1.12 The meters protection class shall be Class II (Double insulated) as per IEC 61140:2016 standard.
- 4.2.1.13 The meters shall have a non-volatile memory capable of data storage and with long-term data retention period of not less than 10 years or for the certified life of the meter or whichever is greater without an electrical supply being supplied to the meter.
- 4.2.1.14 The meters shall have register codes to indicate information like instantaneous power, current credit register, power fail counter, last credit token number, value of last credit token, etc. The values shall be available on the UIU display.
- 4.2.1.15 The principal unit for the measured values shall be the kilowatt-hour (kWh).
- 4.2.1.16 The meter shall have a means of reading the credit register to within a resolution of at least 0.01 kWh for testing purposes.
- 4.2.1.17 The meters shall detect significant reverse energy (SRE) when the line and load wires are swapped.
- 4.2.1.18 The meters shall continue to operate correctly and decrement credit during SRE detection.
- 4.2.1.19 The meters shall have LED indicators for testing and indication of kWh consumption.
- 4.2.1.20 The meters shall have an optical communication port, compliant to IEC62056-21 for accessing information stored inside the meter through a handheld unit.
- 4.2.1.21 The meters shall use PLC communication module for communication to data concentrators and Meter Data Management System (MDMS) to a minimum distance of 1000 meters with success rate of 97% using real time, bidirectional communication of maximum of 5 seconds.

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- 4.2.1.22 The PLC shall comply with IEEE1901.2 using Orthogonal Frequency Division Multiplexing (OFDM) modulation at frequency band up to 500KHZ(G3/PRIME).
- 4.2.1.23 The meters shall be compliant with the Device Language Message Specification/Companion Specification for Energy Metering (DLMS/COSEM) or equivalent communication Protocol.
- 4.2.1.24 The meters shall work under Postpaid Mode or Prepaid Mode. The switch of mode shall be done via meter specific token or optical communication.
- 4.2.1.25 The meters shall be supplied together with three copies of software for interrogating the meter data; and it shall not be possible to reprogram the meters using this software.
- 4.2.1.26 The MCU shall conform to the degree of protection IP 54 as given in IEC 60529. The terminals shall be so designed to ensure protection from ingress of water and dust.
- 4.2.1.27 The MCU enclosure shall be made of UV-stable unbreakable high-grade flame retardant polycarbonate that complies with IEC 60695-2-1 glow wire test. The material shall be of good dielectric and mechanical strength with minimum thickness of 2.0mm.

4.2.2 Functionality Requirements

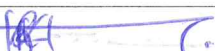
4.2.2.1 Measurement and Control Unit (MCU)

- 4.2.2.1.1 The MCU shall have a load switch to automatically interrupt the load circuit on the expiry of credit balance.
- 4.2.2.1.2 The load switch shall automatically restore the load circuit after token top up.
- 4.2.2.1.3 The meter load switch shall comply with the requirements given in IEC 62053-21:2003.
- 4.2.2.1.4 The meters shall be able to indicate absence or presence of continuous power by use of an Light Emitting Diode (LED)
- 4.2.2.1.5 The meters shall disconnect the load if power failure is detected and connect the load after normalization.
- 4.2.2.1.6 The meters shall have a programmable power limit setting that shall disconnect the load once exceeded and reconnect once the load falls below the set limit.

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- 4.2.2.1.7 The MCU shall have an LED indicator to show the rate of consumption. The pulse rate shall be proportional to current rate of consumption.
- 4.2.2.1.8 The MCU shall have a diagnostic LED to indicate the presence of communication between the MCU and the UIU.
- 4.2.2.1.9 The MCU shall continue metering and decrement credit, regardless of the state of the communications interface or the UIU.
- 4.2.2.1.10 The Live and Neutral shall be DC immune complying with requirements of IEC 61036.
- 4.2.2.1.11 The MCU shall support two elements double circuit measurement. The MCU shall be equipped with two 100A relays (loading switch) both in Live and Neutral circuits. These relays shall operate simultaneously. In case there is an imbalance between the Live circuit and the Neutral circuit, the MCU will take it as a tamper event and record it. The MCU will measure on the higher current without disconnecting the loading switch.
- 4.2.2.1.12 The MCU shall come fitted with an SCSSCAA9 (MC171) compliant data port for programming and interrogating the meter. Two (2) sets of data interrogating and programming probes and software (1 each for optical and SCSSCAA9 ports) shall be provided with the meter sample for evaluation. For the winning bidders, each delivery of 100,000 meters shall have 100 sets of probes and software for use with the optical and the SCSSCAA9 ports.
- 4.2.2.1.13 The MCU shall be supplied together with a plastic card of dimension 85mm x 54 (length x height) mm and material similar to that of a credit card indicating the meter number. The meter serial number shall be engraved on the card together with its bar code version and stored in a magnetic medium with capability of being read out when the card is swiped. No random redundant digits shall be added to the meter number.
- 4.2.2.1.14 The MCU shall be with Nil units pre-loaded (i.e. 0 (Zero) kWh).

4.2.2.2 User Interface Unit (UIU)

- 4.2.2.2.1 The UIU shall comply with 20-digit Standard Transfer Specification (STS) encryption algorithms. All correctly entered tokens shall be registered to eliminate fraud.

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- 4.2.2.2.2 The UIU's Keypad shall be user friendly with a Liquid Crystal Display (LCD) for numeric credit display and language independent pictograms to identified operational features. The LCD shall have a wide viewing angle of 45 deg. to 60 deg. cone, up to one meter distance.
- 4.2.2.2.3 The UIU display shall have at least seven (7)-numerical characters comprising of five integers and two decimals. The UIU display shall in addition have icons; icon information; numeric information display of all meter information such as credit levels, token entry, cumulative kwh, tamper mode etc.
- 4.2.2.2.4 The LCD shall have the height of the display characters for the numeric values not be less than 4.5 mm.
- 4.2.2.2.5 The UIU keypad shall be of 12-key, international standard layout including "information" and "backspace" keys.
- 4.2.2.2.6 The UIU enclosure material shall be UV-stable polycarbonate/ABS blend with flame retardant as per IEC 60695-2-1.
- 4.2.2.2.7 The UIU shall conform to the degree of protection IP 54 as specified in IEC 60529.
- 4.2.2.2.8 The UIU shall communicate with MCU through Power Line Carrier (PLC) communication link for a distance not less than one hundred (100) meters.
- 4.2.2.2.9 The UIU shall be an interchangeable unit and it shall be possible to view the paired MCU on the UIU.
- 4.2.2.2.10 The UIU shall enable loading the MCU with many pre-purchased units of credit, without loss of any existing credit balance.
- 4.2.2.2.11 The UIU shall, upon acceptance of a valid token, credit the exact amount contained on the token to the appropriate register in the meter and shall increment the register by this amount.
- 4.2.2.2.12 The UIU shall transfer the credit in kWh.
- 4.2.2.2.13 The UIU shall display the cumulative kilowatt-hour register.
- 4.2.2.2.14 The UIU shall have a means to remove digits from a partially entered number sequence-backspace key.

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- 4.2.2.2.15 The UIU shall have the ability to recall at least the last five successful credit tokens entered and the associated dates and time.
- 4.2.2.2.16 The UIU shall be able to indicate the meter software.
- 4.2.2.2.17 The UIU shall indicate the status of the incoming supply.
- 4.2.2.2.18 The UIU shall indicate the credit status.
- 4.2.2.2.19 The UIU shall indicate token acceptance or rejection.
- 4.2.2.2.20 The UIU shall give low credit warning by means of a flag on UIU display and audio alarm. The UIU shall have option of muting the low credit warning sound by entering a code on the UIU.
- 4.2.2.2.21 The UIU shall have a buzzer that will give a feedback on key press, Token Accept and Reject melodies, low-credit alarms as a factory-programmable option.
- 4.2.2.2.22 The UIU keypad shall have backlight to enable keying of tokens in the dark.
- 4.2.2.2.23 The UIU shall be wall mountable.
- 4.2.2.2.24 The UIU shall be able to communicate with MCU when power is off via a long life 2xAA alkaline battery. The batteries shall be supplied with the UIU.


4.3 Electrical Requirements

- 4.3.1 The meters shall be operated from mains with reference values of 230V, 50 Hz \pm 5%, with a load switching voltage range from 0.4Un to 1.3Un. The load switch shall be of bi-stable type designed and manufactured in accordance with the International Standard IEC 61810- 1, as well as meet the overload and short circuit requirement of IEC 61036 / 61037. The Latching relay shall conform to the load switching capabilities as per relevant IEC standard.
- 4.3.2 The load switch shall interrupt the supply when the voltage is below 0.4 Un and above 1.3Un.
- 4.3.3 The load switch shall automatically restore supply within a minute when the voltage falls within 0.4 Un – 1.3 Un.

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4.3.4 The meters shall be connectable for 2-wire systems, a permanent connection drawing of which shall be printed on the meter body. Stickers of any kind shall not be accepted.

4.3.5 The meter shall have Reference Standard Electrical Design Parameters as in Table 1.

Table 1: Summary of Electrical Parameters

Measurement and Control Unit	
Electrical Parameters	
Accuracy	kWh Class 1 (IEC 62053-21)
Rated Nominal Voltage (U_n), Frequency (Hz)	230V, 50Hz \pm 5%
Load switching voltage range	0.4 U_n to 1.3 U_n
Base Reference current, I_b	5A
Max. Voltage circuit burden	2W and 10 VA @230V, 50Hz, 30° C
Max. Current circuit burden	4VA @ 5A, 50Hz, 30° C
Maximum Current I_{max} (A)	80 A.
Protective class	Class II (double insulated)
Accurate metering range	0.05 I_b to 1.2 I_{max}
Starting current	0.2% I_b
Running with no-load	No more than one pulse on application of 0.4 U_n - 1.3 U_n
Short circuit current	30 I_{max}
Meter Constant	1000 imp/kwh
Disconnection Device	
Type	Single pole latching contactor, 100 A.
Insulation; Over voltage and Surge Protection	
Insulation classification	Protective Class II
Insulation level	At least 4 kV rms for 1 minute
Over voltage withstand	400 VAC for 48 hours
Voltage impulse withstand	At least 6 kV, 1.2/50 μ s (IEC 62052-11) with 2 Ω source impedance
Current impulse withstand	At least 5kA, 8/20 μ s
Lightning Surge Withstand	At least 30kA, 4/10 μ s

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Electromagnetic compatibility

Electrostatic discharge	15 kV air discharge
Immunity to HF fields	80 MHz to 2 GHz @ 10V/m with load; 80 MHz to 2 GHz @ 30V/m no load- Accuracy not affected by magnetic fields from all sides-front, sides, top and bottom of the meter.
Immunity to Fast Transient Bursts	4 kV
Radio interference	Complies with requirements for CISPR 22, IEC 61000-4-2,3,4,6

Communication Circuitry

Type	Power Line Carrier
Rated Impulse Voltage	Peak Voltage 6 kV (1.2/50µs) waveform (IEC 62052-11) Protective Class II
Insulation level	4 kV _{rms} (1 Minute) - IEC 62052-11 Protective Class II
Communication Protocol	DLMS/COSEM
Communication Range	>100m for MCU to CIU and >1000m for MCU to data concentrator



4.4 Interoperability Requirements

4.4.1 The Manufacturer shall produce meters that fully meet the requirements of the IEC 62055-51:2007 on Standard Transfer Specification protocol and hence:

- Facilitates interoperability amongst hardware, software and meters supplied by other manufacturers.
- Does not lock KPLC to only the bidder or any one supplier or manufacturer in its future procurement of prepayment meters, software or hardware.
- The meters shall be interoperable with the existing KPLC Smart Metering Management System. The bidder shall be able to demonstrate this before award.

4.5 Quality Management System

4.5.1 The supplier shall submit a Quality Assurance Plan (QAP) that will be used to ensure that the meter design, physical properties, tests and documentation, will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001: 2008 or ISO 9001: 2015.

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- 4.5.2 Copies of quality management certifications including copy of valid and relevant ISO 9001: 2008 or ISO 9001: 2015 Certificate for international manufacturers and/or KEBS Standardization Certificate for local manufacturers shall be submitted with the tender for evaluation.

5 TESTS AND INSPECTIONS

- 5.1 The meters shall be tested in accordance with the requirements of IEC 62053-21:2003 and provisions of this specification. It shall be the responsibility of the supplier to perform or to have performed the tests specified.
- 5.2 The bidder shall submit copies of Type Tests Reports for each type of meter offered with the tender for technical evaluation. The Type Test Reports shall have been issued by a third-party testing laboratory, accredited to ISO/IEC 17025. The accreditation certificate to ISO/IEC 17025 for the same third-party testing laboratory used shall also be submitted with the tender document (all in English Language).
- 5.3 Routine and sample test reports for the meter to be supplied shall be submitted to KPLC for approval before shipment/delivery of the goods.
- 5.4 All acceptance tests as stipulated in the relevant standards shall be carried out by the supplier and shall be witnessed by KPLC Engineers before shipment. KPLC shall meet the full costs of two engineers, for meter inspection and acceptance testing at the manufacturer's facility.
- 5.5 On receipt of the goods KPLC will perform any of the tests specified in order to verify compliance with this specification.
- 5.6 The supplier shall replace without charge to KPLC the meters, which upon examination, test or use; fail to meet any of the requirements in the specification.
- 5.7 The following tests shall be conducted on the meter as per IEC 62053-21: 2003 and other relevant standards:-

5.7.1 Tests of Insulation Properties

- 5.7.1.1 Impulse Voltage Test
- 5.7.1.2 AC High Voltage Test
- 5.7.1.3 Insulation Test

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5.7.2 Test of Accuracy Requirements

- 5.7.2.1 Tests on Limits of Error
- 5.7.2.2 Interpretation of Test Results
- 5.7.2.3 Test of Meter Constant
- 5.7.2.4 Test of Starting Conditions
- 5.7.2.5 Test of No-load Condition
- 5.7.2.6 Test of Ambient Temperature Influence
- 5.7.2.7 Test of Repeatability Error
- 5.7.2.8 Test of Influence Quantities

5.7.3 Test of Electrical Requirements

- 5.7.3.1 Test of Power Consumption
- 5.7.3.2 Test of Influence of Supply Voltage
- 5.7.3.3 Test of influence of Short-term Over-currents
- 5.7.3.4 Test of Influence of Self-heating
- 5.7.3.5 Test of Influence of Heating
- 5.7.3.6 Test of Influence of Immunity to Earth Faults

5.7.4 Test for Electromagnetic Compatibility

- 5.7.4.1 Radio Interference Measurement
- 5.7.4.2 Fast Transient Burst Test
- 5.7.4.3 Test of Immunity to Electrostatic Discharges
- 5.7.4.4 Test of Immunity to electromagnetic HF Fields

5.7.5 Test for Climatic Influences

- 5.7.5.1 Dry Heat Test
- 5.7.5.2 Cold Test
- 5.7.5.3 Damp Heat Cyclic Test

5.7.6 Test for Mechanical Requirements

- 5.7.6.1 Vibration Test
- 5.7.6.2 Shock Test
- 5.7.6.3 Spring Hammer Test
- 5.7.6.4 Protection Against Penetration of Dust and Water
- 5.7.6.5 Test of Resistance to Heat and Fire

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5.7.7 Functional Tests

- 5.7.7.1 Open Cover tamper detection.
- 5.7.7.2 Token validation test
- 5.7.7.3 Decrementing of units when connected to Load.
- 5.7.7.4 Automatic interrupting of the load circuit on expiry of units
- 5.7.7.5 Test of credit balance and debit
- 5.7.7.6 Test of disconnect of supply when credit decrement to zero
- 5.7.7.7 Test of reconnecting supply on providing credit
- 5.7.7.8 Test to disconnect supply if load/current exceeds the preset value of the meter
- 5.7.7.9 Test to reconnect supply if load current falls within present value.

5.7.8 Additional Tests

- 5.7.8.1 Glow wire testing for polycarbonate material
- 5.7.8.2 Accuracy tests in the presence of harmonics
- 5.7.8.3 Influence of d.c and even harmonics
- 5.7.8.4 Measurement of Total energy – Effect of Harmonics
- 5.7.8.5 Magnetic induction of external origin (AC & DC)

5.8 Minimum Testing Facilities

The manufacturer shall have the necessary minimum testing facilities for carrying out the following Routine Tests:

- (a) AC high voltage test
- (b) Insulation resistance test
- (c) Test of limits of errors
- (d) Test of meter constant
- (e) Test of starting condition
- (f) Test of no load condition
- (g) Repeatability of error test
- (h) Test of power consumption
- (i) Tamper conditions - as per this specification
- (j) Transportation Test.

NB: The manufacturer shall have duly calibrated Equivalent Series Resistance (ERS) meter of Class 0.5 accuracy or better.

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6 MARKING AND PACKING

6.1 Marking

Markings shall comply with IEC 61010-1 unless otherwise specified in other parts of IEC 61557. The measuring equipment shall carry the following marking which shall be clearly readable and indelible (in English Language) on the meter and of at least 4mm figure height.

The following information shall be marked on each meter.

- (a) The Standard Transfer Specification (STS) compliant serial number, in the preferred format known as a national meter number,
- (b) The STS compliance logo,
- (c) The inscription "**Property of KPLC.**",
- (d) Name or trade mark of the manufacturer;
- (e) Wiring Connection diagram.
- (f) Country of Origin
- (g) Type/model
- (h) Meter number
- (i) Barcode comprising of meter serial number without blank spaces
- (j) Standard(s) to which the meter complies
- (k) Year of Manufacture
- (l) Guarantee – 5 Years
- (m) KEBS Mark

6.2 Packing

- 6.2.1 The meters shall be packaged in such a manner as to minimize damage and entry of moisture during transportation and handling.
- 6.2.2 The meters shall be packed in suitable groups and / or batches with consecutive serial numbers. Packaging shall be done only after KPLC approval
- 6.2.3 The meters shall be packaged in multiples of ten unless where the number of meters in a group/batch does not make a multiple of ten.

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6.2.4 The number of meters packaged in a group and/or batch for handling/lifting/carrying by an operator manually shall be such that their weight does not exceed 15 kg.

6.2.5 The supplier shall indicate the delivery time versus quantities of each type of meter and his production capacity.

7 DOCUMENTATION

7.1 The bidder shall submit its tender complete with technical documents required by Annex A (Guaranteed Technical Particulars) for tender evaluation. The technical documents to be submitted (all in English language) for tender evaluation shall include the following:

- a) Fully filled clause by clause guaranteed technical particulars (GTP) signed by the manufacturer;
- b) Meter drawing giving all the relevant dimensions;
- c) Wiring diagrams;
- d) Users and operational manuals.
- e) Copies of the Manufacturer's catalogues, brochures, drawings and technical data;
- f) Sales records for the last five years and at least four customer reference letters;
- g) Details of manufacturing capacity and the manufacturer's experience;
- h) Copies of required type test reports by an Independent Third-Party Testing Laboratory accredited to ISO/IEC 17025; The test certificates shall bear the product serial number of meter on offer. KPLC reserves the right to demand repetition of some or all the type tests in presence of KPLC's representative, which acceptance should be submitted together with the offer. The retest results of the 3rd Party Laboratory binding and not be disputed. All type test reports of the meters shall be approved by Head of Standards, KPLC, before commencement of supply. Type test reports of offered meter carried out during last three years shall be valid. Type tests conducted in manufacturer's own laboratory and certified by testing bodies shall not be acceptable.
- i) Copy of Accreditation Certificate to ISO/IEC 17025 for the third-party testing laboratory;
- j) Valid copies of ISO 9001:2008 or ISO 9001:2015 certificate for international manufacturers and/or KEBS standardization quality mark certificate for local manufacturers.

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- k) Evidence of the manufacturer having supplied a minimum of 200,000 pieces of the meter type offered to similar utilities in the past two years.
- l) Copies of DLMS/COSEM certificates
- m) Current e-mail addresses, fax and telephone numbers of the National / International Testing / Calibration Laboratories and Meter Certification bodies used to test the meter on offer.

NOTE: The bidder shall complete, clearly, all the clauses in of the Schedule of Guaranteed Technical Particulars in the Annex. This shall form the basis of evaluation of the submitted tender. Failure to complete this Appendix shall render the tender non-responsive. The tenderers shall indicate the details of their offer where it is different from these requirements. Where the requirement is the same, they shall indicate what is offered. Insertions such as “noted”, “agreed”, “comply” etc. shall be considered as non-responsive where a specific response is called for.

7.2 The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Company for approval before manufacture:

- a) Fully filled clause by clause Guaranteed Technical Particulars (GTP) signed by the manufacturer;
- b) Design Drawings with details of low voltage measurement instruments to be manufactured for KPLC. Quality Assurance Plan (QAP) that will be used to ensure that the design, material; workmanship, tests, service capability, maintenance and documentation will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008.
- c) The QAP Statement shall include a matrix of important raw materials and components (including the measurement and computing chips, memory chips, display modules, key electronic components and the battery) names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested and copies of test certificates in respect of bought out accessories.
- d) An outline of the proposed work and programme sequence.
- e) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- f) The successful bidder shall within 30 days of placement of order, submit a matrix/list of raw materials and test certificates of the selected accessories and the names of sub-suppliers whether same or different from those furnished alongside the bids.
- g) Detailed test program to be used during factory acceptance testing;

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- h) All documentation necessary for safety of the equipment as specified in IEC 61010-1 clause 5.4 shall be provided with the instrument.

7.3 The supplier shall submit recommendations for use, care, storage and routine inspection/testing procedures, all in the English Language, during delivery of the meters to KPLC stores.

8 INFORMATION AND WARRANTY (IN CASE OF TENDER AWARD)

8.1 Warranty

8.1.1 The supplied meters, MCUs, UIUs and associated software/hardware shall be guaranteed by Warranty against any defects, which may develop due to faulty material, calibration, transportation or workmanship for a period of fifty-four (54) months from the date of successful commissioning certificate for KPLC or sixty (60) months from dispatch, whichever is later. All defective meters shall be replaced at the supplier's cost within one (1) month of receipt of intimation.

8.1.2 All software supplied shall be updated by the supplier at no extra cost while any required changes, e.g. tariff changes, statutory changes, etc. shall be implemented free of cost during the warranty period and beyond.

8.1.3 The successful bidder/supplier shall observe performance of their meter on site for a period of at least one (1) year and monitor accuracy of the same independently and submit a performance evaluation report of the same.

8.2 Samples

8.2.1 The tenderer shall submit three (3) MCUs and three (3) UIUs samples together with the tender documents. Samples shall not be returned to the tenderers.

8.2.2 The submitted meter samples shall be subjected to accuracy tests at KPLC's Meter Central Laboratory and independent third-party accredited laboratory of KPLC's choice to verify compliance with all the requirements of IEC 62053-21:2003 other requirements of this specification.

8.2.3 The samples of the meters offered shall be submitted together with test tokens for; different Power Limit Settings and resets for the same, Credit and Clear Credit Tokens to aid in the testing of the meters. The manufacturer might be required to provide more tokens at no extra cost.

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8.2.4 Bidders are advised that the Laws of Kenya require that the Kenya Bureau of Standards must approve any new meter being introduced in the country. To this end, Bidders shall furnish the Bureau with 4 (four) samples of each meter type to be supplied. Bids submitted without the meter type approval from the Bureau will NOT be considered non-responsive. However, the winning Bidder must submit this approval before the signing of the supply contract.

8.2.5 Bidders may communicate directly with the Kenya Bureau of Standards on this matter through the following address:

The Managing Director
Kenya Bureau of Standards,
P.O. Box 54974, 00200,
Nairobi, Kenya.

Tel: (+254 020) 605490, 602350

Fax: (+254 020) 604031

Email: info@kebs.org

Web: <http://www.kebs.org>

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ANNEX A (Normative): Guaranteed Technical Particulars for Split Prepayment Static Meters for Active Energy Measurement(to be filled and signed by the *Manufacturer* and submitted together with a sample meter, relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, sales records for previous five years, four customer reference letters, details of manufacturing capacity, the manufacturer's experience and copies of complete type test certificates and type test reports for tender evaluation, all in English Language)

Clause number	KPLC requirement		Bidder's offer (indicate full details of the offered for the prepayment meter)
	Manufacturer's Name and address		Specify
	Brand name or designation		Specify
	Country of Manufacture		Specify
	Bidder's Name and address		Specify
1.	Scope		Specify
2.	Normative References		Specify
3.	Terms, Definitions and Abbreviations		Specify
4.	REQUIREMENTS		
4.1	Operating Conditions		
4.1.1	Operating environmental conditions	Altitude	State
		Operating temperature	State
		Storage temperature	State
		Humidity range - Rel. humidity	State
		Pollution category	State
4.1.2	System Characteristics	Compatible electrical system	State
		Nominal voltage and frequency	State
4.2	Design and Construction Requirements		
4.2.1	General Requirements -Standards applicable		State
4.2.1.1	The Measurement and Control Unit (MCU) shall be of DIN rail mounting with locking clip, to fit to a 35 mm Din rail.		Specify
4.2.1.2	Distance of MCU and UIU communication via PLC		Specify
4.2.1.3	The meters constructed as 1 phase 2-wire direct connected prepayment meter.		Specify

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Clause number	KPLC requirement	Bidder's offer (indicate full details of the offered for the prepayment meter)
4.2.1.4	(a) Connection to the meter Bottom-In, Bottom-Out with Line -in and Neutral-in terminals at the base level to allow racking of the meter on a test bench.	Specify
	(b) Meter terminals protection cover (transparent) with sealable screws against tampering and ingress of water	Specify
	(c) Material of the screws	
4.2.1.5	The MCU dimensions not exceeding: Height = 170 mm; Width = 60 mm; and Depth = 95 mm; and meter base on the width side where the Din rail mount shall be located.	Specify
4.2.1.6	The MCU body ultrasonically sealed for life without screws on the MCU body except for the termination of cables.	Specify
4.2.1.7	Terminal cover open detection mechanism	Specify
(a)	Supply with load switch in open mode and commissioning code (token) and installer can open terminal cover when MCU not activated	Specify
(b)	Activation of cover open detection function at installation of MCU by inputting a commissioning code	Specify
(c)	Terminal cover detect opening of cover and MCU disconnects as well as record tamper event	Specify
4.2.1.8	MCU sealed and its printed circuit boards conformal coated in a manner so as not to allow malfunction due to ingress of moisture, vermin, dust, chemicals and temperature extremes.	Specify
4.2.1.9	(a) Meters terminal holes and screws of Moving-cage type made of brass or nickel-plated brass for high conductivity and corrosion resistance	Specify type and class of brass and reference standard
	(b) Meter terminals with continuous current rating of at least 125%Imax	Specify
4.2.1.10	Terminal holes of at least 10-mm diameter and 15mm in depth. The dimension from the Line-in, Neutral-in terminal holes to meter base not exceeding 20mm.	Specify
4.2.1.11	The meter's terminal screw inserts sealable with utility wire seals.	Specify
4.2.1.12	The meter protection class II (Double insulated)	Specify class and reference standard

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Clause number	KPLC requirement	Bidder's offer (indicate full details of the offered for the prepayment meter)
4.2.1.13	Non-volatile memory capable of data storage and with long-term data retention period of not less than 10 years or for the certified life of the meter or whichever is greater without an electrical supply being supplied to the meter.	Specify type of memory and the period of data retention
4.2.1.14	Meter register codes to indicate information like instantaneous power, current credit register, power fail counter, last credit token number, value of last credit token, etc. The values shall be available on the UIU display.	Specify all the codes
4.2.1.15	Principal unit for the measured values	Specify
4.2.1.16	Means of reading the credit register to within a resolution of at least 0.01 kWh for testing purposes.	Specify
4.2.1.17	Detection of significant reverse energy (SRE) when the line and load wires are swapped	Specify
4.2.1.18	Meter to continue to operate correctly and decrement credit during SRE detection	Specify
4.2.1.19	LED indicators for testing and indication of kWh consumption.	Specify
4.2.1.20	Optical communication port, compliant to IEC62056-21 for accessing information stored inside the meter through a handheld unit.	Specify
4.2.1.21	(a) PLC communication module for communication to data concentrators and Meter Data Management Systems	Specify
	(b) Minimum distance of PLC communication	Specify
	(c) Success rate (%) using real time, bidirectional communication of maximum of 5 seconds	Specify
4.2.1.22	Compliance with IEEE1901.2 using OFDM modulation at frequency band up to 500Khz (G3/PRIME).	Specify
4.2.1.23	Compliance with the DLMS/COSEM or equivalent communication protocol.	Specify
4.2.1.24	(a) Ability of meter to work under postpaid mode or prepaid mode. The switch of mode shall be done via meter specific token or optical communication.	Specify
	(b) Method of switching to and from postpaid and prepaid modes	Specify


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Clause number	KPLC requirement	Bidder's offer (indicate full details of the offered for the prepayment meter)
4.2.1.25	Meters to be supplied together with three copies of software for interrogating the meter data; and it shall not be possible to reprogram the meters using this software	Specify
4.2.1.26	(a) MCU to conform to the degree of protection IP 54	Specify
	(b) Terminals of the MCU to be so designed so as to ensure protection from ingress of water and dust.	Specify
4.2.1.27	Material of the MCU enclosure	Specify material and reference standard
4.2.2	Functionality Requirements	
4.2.2.1	Measurement and Control Unit (MCU)	
4.2.2.1.1	MCU with a load switch to automatically interrupt the load circuit on the expiry of credit balance.	Specify
4.2.2.1.2	Load switch to automatically restore the load circuit after top up.	Specify
4.2.2.1.3	Reference standard for the meter load switch	Specify the reference standard
4.2.2.1.4	MCU indication for absence or presence of continuous power.	Specify
4.2.2.1.5	Disconnection of the load if power failure is detected and connect the load after normalization.	Specify
4.2.2.1.6	Programmable power limit setting that disconnects the load once exceeded and reconnect once the load falls below the set limit.	Specify
4.2.2.1.7	Light Emitting Diode (LED) to indicate rate of consumption. The pulse rate to be proportional to current rate of consumption	Specify
4.2.2.1.8	Diagnostic LED to indicate the presence of communication between the MCU and the UIU.	Specify
4.2.2.1.9	The MCU to continue metering and decrement credit, regardless of the state of the communications interface or the UIU.	Specify
4.2.2.1.10	Immunity to DC for the Live and Neutral circuits of the MCU	Specify
4.2.2.1.11	(a) MCU with two elements double circuit measurement.	Specify

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Clause number	KPLC requirement	Bidder's offer (indicate full details of the offered for the prepayment meter)
	(b) MCU equipped with 100A relay (loading switch) both in Live and Neutral circuits and operating simultaneously	Specify
	(c) In case there is an imbalance between the Live circuit and the Neutral circuit, the MCU takes it as a tamper event and record it. The MCU then measure on the higher current without disconnecting the loading switch.	Specify
4.2.2.1.12	(a) MCU to be fitted with an SCSSCAAA9 (MC171) compliant data port for programming and interrogating the meter.	Specify
	(b) Two (2) sets of data interrogating and programming probes and software (1 each for optical and SCSSCAAA9 ports) shall be provided with the meter sample for evaluation	To Comply
	(c) For the winning bidders, each delivery of 100,000 meters shall have 100 sets of probes and software for use with the optical and the SCSSCAAA9 ports.	To comply
4.2.2.1.13	The MCU shall be supplied together with a plastic card of dimension 85mm x 54 (length X height) mm and material similar to that of a credit card indicating the meter number. The meter serial number shall be engraved on the card together with its bar code version and also stored in a magnetic medium with capability of being read out when the card is swiped. No redundant digits shall be in the card	Specify
4.2.2.1.14	The MCU shall be with Nil Units pre-loaded (i.e. 0 (Zero) kWh)	Comply
4.2.2.2	User Interface Unit (UIU)	
4.2.2.2.1	The UIU comply with 20-digit (STS) encryption algorithms. All correctly entered tokens to be registered to eliminate fraud.	Specify
4.2.2.2.2	User friendly UIU's keypad with a LCD display for numeric credit display and language independent pictograms to identified operational features.	Specify
4.2.2.2.3	The UIU display shall have at least seven 7-numerical characters comprising of five integers and two decimals and Icons, Icon information and numeric information	Specify all info to be displayed

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4.2.2.2.4	The height of the LCD display characters for the numeric values to not be less than 4.5 mm.	Specify
4.2.2.2.5	UIU keypad of 12-key, international standard layout including 'information' and 'backspace' keys	Specify
4.2.2.2.6	UIU enclosure material to be UV-stable polycarbonate and fire-redundant	Specify material and applicable standard
4.2.2.2.7	The UIU conforming to the degree of protection IP 54.	Specify
4.2.2.2.8	The UIU and MCU communicate through PLC communication link for distance not less than one hundred (100) meters.	Specify
4.2.2.2.9	Interchangeability of UIU unit and possibility to view the paired MCU on the UIU.	Specify
4.2.2.2.10	UIU enables loading the meter with a number of pre-purchased units of credit, without loss of any existing credit balance.	Specify
4.2.2.2.11	The UIU upon acceptance of a valid token credit, the exact amount contained on the token recorded to the appropriate register in the meter and increment the register by similar amount.	Specify
4.2.2.2.12	The UIU to transfer the credit in kWh.	Specify
4.2.2.2.13	The UIU to display the cumulative kilowatt-hour register.	Specify
4.2.2.2.14	The UIU to have a means to remove digits from a partially entered number sequence-backspace key.	Specify
4.2.2.2.15	The UIU to have the ability to recall at least the last five successful credit tokens entered and the associated dates and time.	Specify
4.2.2.2.16	The UIU to be able to indicate the meter software.	Specify
4.2.2.2.17	The UIU to indicate the status of the incoming supply.	Specify
4.2.2.2.18	The UIU to indicate the credit status.	Specify
4.2.2.2.19	The UIU to indicate token acceptance or rejection.	Specify
4.2.2.2.20	The UIU to give low credit warning by means of a flag on UIU display and audio alarm. The UIU to have option of muting the low credit warning sound by entering a code on the UIU.	Specify
4.2.2.2.21	UIU has a buzzer that gives feedback on key press, token acceptance and rejection melodies, low credit alarms as a factory programmable option	Specify

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4.2.2.2.22	UIU keypad has backlight to enable keying of tokens in the dark.	Specify
4.2.2.2.23	UIU is wall mountable	Specify
4.2.2.2.24	UIU is able to communicate with MCU when power is off via 2xAA alkaline battery. The Batteries to be supplied with the UIU.	Specify
4.3	Electrical requirements	Specify
4.3.1	The meter is operated from mains with reference values of 230V, 50 Hz, with a load switching voltage range from 0.4Un to 1.3Un.	Specify and reference standard of the load switch
4.3.2	The load switch is able to interrupt the supply when the voltage is below 0.4 Un and above 1.3Un.	Specify
4.3.3	The load switch automatically restore supply within a minute when the voltage falls within 0.4Un – 1.3 Un.	Specify
4.3.4	The meters is connectable for 2-wire systems, drawing of which shall be printed on the meter body. Stickers of any kind shall not be accepted	Specify
4.3.5	Summary of electrical parameters as per table 1 of specification	Specify
(a)	Meter accuracy class	Specify class and reference standard
(b)	Rated Nominal Voltage (Un)	Specify
(c)	Load switching voltage range	Specify
(d)	Maximum Voltage Circuit burden (W and VA)	Specify
(e)	Base Reference Current, Ib	Specify
(f)	Maximum Current circuit burden (VA)	Specify
(g)	Maximum Current Imax (A)	Specify
(h)	Protective class	Specify class and reference standard
(i)	Accurate Metering Range	Specify
(j)	Starting Current (as a percentage of Ib)	Specify
(k)	Running with no-load	Specify
(l)	Short Circuit current (as a function of Imax)	Specify
(m)	Meter constant	Specify

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Clause number	KPLC requirement	Bidder's offer (indicate full details of the offered for the prepayment meter)
(n)	Disconnection device	Specify type and current rating
(o)	Insulation class	Specify and reference standard
(p)	Insulation Level (kV)	Specify and reference standard
(q)	Overvoltage withstand (VAC for 48 hours)	Specify and reference standard
(r)	Voltage Impulse Withstand (KV)	Specify withstand value and reference standard
(s)	Current Impulse withstand (kA/microsecs)	Specify withstand value and reference standard
(t)	Lightning Surge Withstand	Specify withstand value and reference standard
(u)	EMC-Electrostatic discharge (kV air discharge)	Specify rating and reference standard
(v)	Immunity to HF Fields	Specify rating and reference standard
(w)	Immunity to Fast Transient Bursts	Specify rating and reference standard
(x)	Immunity to Radio interference	Specify rating and reference standard
(y)	Rated impulse withstand voltage of PLC (kV)	Specify withstand value and reference standard
(z)	Insulation level of PLC (kVrms)	Specify withstand value and reference standard
(aa)	Communication Protocol	Specify
(bb)	Communication Range of PLC	Specify
4.4	Interoperability Requirements	
4.4.1	The meter's applicable standards	Specify
(a)	Interoperability of the meter on offer among hardware, software and meters supplied by other manufacturers	Specify
(b)	Non-proprietary technology that does not lock KPLC to only one bidder or any one manufacturer in its future procurement of software, hardware or meters	Specify

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Clause number	KPLC requirement	Bidder's offer (indicate full details of the offered for the prepayment meter)
(c)	Meter interoperable with the existing KPLC smart metering management system. The bidder shall be able to demonstrate this capability before award.	Specify
4.5	Quality Management System	
4.5.1	Quality Assurance Plan	Provide
4.5.2	Copy of valid ISO 9001:2008, ISO 9001:2015 Certificate for international manufacturers and/or KEBS standardization certificate for local manufacturers	Provide
5.	TESTS AND INSPECTIONS	
5.1	Test standards and responsibility of carrying out tests	Provide
5.2	Copies of valid Type Test Reports and 3 rd Party testing lab accreditation certificate submitted with tender	Provide
5.3	Routine and sample test reports to be submitted by supplier to KPLC for approval before shipment	Provide
5.4	Acceptance tests to be witnessed by KPLC Engineers at factory before shipment	Provide
5.5	KPLC to perform any of the tests independently in order to verify compliance with this specification	comply
5.6	Supplier to replace without charge to KPLC meters which upon examination, test, or use, fail to meet any requirements in the specification	comply
5.7	Required Type Tests and Routine Acceptance Tests	Specify
5.8	Minimum testing facilities	Specify
6	MARKING AND PACKING	
6.1	Marking as per specification	Specify
6.2	Packing as per specifications	Specify
7	DOCUMENTATION	
7.1	Documents to be submitted with GTPs for tender evaluation	Provide
7.2	Documents to be submitted to KPLC for approval before manufacture (if tender awarded)	Provide
8	INFORMATION AND WARRANTY	

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TITLE:

SPECIFICATION FOR SINGLE-PHASE SPLIT PREPAYMENT DIN RAIL MOUNTING STATIC WATT - HOUR METERS FOR ACTIVE ENERGY- Using PLC as Medium of Communication Between MCU and UIU

Doc. No.

**KP1/6C/4/1/TSP/14/1
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Clause number	KPLC requirement	Bidder's offer (indicate full details of the offered for the prepayment meter)
8.1	Fifty four (54) months warranty from date of successful commissioning certificate for KPLC or Sixty (60) months warranty from the date of dispatch whichever is later	Specify
8.1.2	Software supplied shall be updated by the supplier at no extra cost while any required changes, e.g. tariff changes, statutory changes, etc. shall be implemented free of cost during the warranty period and beyond.	Specify
8.1.3	The successful bidder/supplier shall observe performance of their meter on site for a period of at least one (1) year and monitor accuracy of the same independently and submit a performance evaluation report of the same.	Specify
8.2	Samples	Specify
8.2.1	The tenderer shall submit Three (3) MCUs and three (3) UIUs samples together with the tender documents (N.B. Samples shall not be returned to the tenderers).	Provide
	The submitted meter samples shall be subjected to type and routine tests at KPLC's Meter Central Laboratory and also a third-party accredited laboratory to verify the requirements of IEC 62053-21:2003 and to verify responsiveness to other requirements of this specification.	Comply
8.2.2	Sample of meter offered to be submitted together with test tokens for different power limit settings and resets for the same, credit and clear credit tokens to aid in the testing of the meters. The manufacturer may be required to provide tokens at no extra cost	Provide

.....
Manufacturer's Name, Signature, Stamp and Date

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